# A FLUID PRESSURIZATION DEVICE

## FIELD OF INVENTION

THIS INVENTION relates to a fluid pressurization device.

It relates also to an ordnance deflagration device including the fluid pressurization device.

## SUMMARY OF INVENTION

According to a first aspect of the invention there is provided a fluid pressurization device including:

a pressure container defining a fixed volume, in use;

a first resiliently deformable inflatable bladder for containing a fluid under pressure, that is located within the pressure container;

a second resiliently deformable inflatable bladder for containing a fluid under a relatively higher pressure than the pressure of the fluid in the first bladder and that is located within the pressure container adjacent the first bladder and that is operable to contain a fluid under pressure; and

releaseable holding means for initially holding the second bladder at a fixed volume when inflated to thereby hold the fluid contained therein under pressure, and for releasing the second bladder thereby permitting the second bladder to expand and exert a force on the first bladder for pressurizing the fluid contained therein.

The first bladder may contain a volatile fluid under pressure and the second bladder may contain a non-volatile fluid at a relatively higher pressure than the pressure of the fluid in the first bladder.

The first bladder may have an opening in which a valve is located, through which fluid can be introduced into and discharged from the first bladder.

The second bladder may have an opening including a valve, through which the second bladder can be inflated with fluid.

The releasable holding means may comprise a flexible sheet element that is wrapped around the second bladder to form a roll surrounding the second bladder wherein portions of the sheet element overlap and contact one another, the rolled-up sheet element being in contact with the second bladder, an inner side of the pressure container and the first bladder in an arrangement wherein frictional forces acting between said overlapping portions of the sheet element and the second bladder in a hoop direction and frictional forces acting between said sheet element and the pressure container and the first bladder, respectively, resist unrolling of the sheet element, in use.

The sheet element may be configured and the first and second bladders may be located in the pressure container, in an arrangement permitting gradual unrolling of the sheet element when fluid is discharged from the first bladder, causing a reduction in size of the first bladder and a consequent reduction in the frictional

forces acting between said overlapping portions of the sheet element and the second bladder and the pressure container.

The pressure container may have a frusto-conical shape in said in-use configuration thereof.

The first bladder may have a frusto-conical shape when inflated.

The second bladder may have a frusto-conical shape when inflated.

The sheet material may be tapered towards one end thereof when viewed in plan view, thereby permitting the sheet element to form a roll around the second bladder which has a frusto-conical shape conforming substantially to the shape of the second bladder when inflated.

A relatively narrower end of the sheet element may be wrapped around a relatively narrower end of the second bladder, thereby resulting in the frictional forces acting between the overlapping portions of the sheet element in a hoop direction at said narrower ends, being relatively less that the frictional forces acting in a hoop direction between the overlapping portions of the sheet element at a relatively wider end of the sheet element.

The sheet element may be of fabric material.

The pressure container may be in the form of a flexible bag of a fabric material.

According to a second aspect of the invention there is provided an ordnance deflagration device including

a fluid pressurization device including:

a) a pressure container defining a fixed volume, in use;

b) a first resiliently deformable inflatable bladder containing a combustible fluid under pressure, that is located within the pressure container, the first bladder having an opening in which a valve is located, through which fluid can be discharged from the first bladder having an opening in which a valve is located, through which fluid can be discharged from the first bladder;

c) a second resiliently deformable inflatable bladder containing a non-volatile fluid under a relatively higher pressure than the pressure of the combustible fluid in the first bladder and that is located within the pressure container adjacent the first bladder; and

d) releasable holding means for initially holding the second bladder at a fixed volume when inflated to thereby hold the fluid contained therein under pressure, and for releasing the second bladder thereby permitting the second bladder to expand and exert a force on the first bladder for pressurizing the fluid contained therein; and

a torch that is connected in flow communication with the combustible fluid contained in the first bladder thereby to ignite the fluid to produce a flame that can be used to burn through the casing of unexploded ordnance and into explosive material contained therein, to cause the destruction of said ordnance.

The fluid pressurization device may be equivalent to the fluid pressurization device described and defined hereinabove in accordance with the first aspect of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the invention are described hereinafter by way of a non-limiting example of the invention, with reference to and as illustrated in the accompanying diagrammatic drawings. In the drawings:

Figure 1 shows a schematic perspective view, showing hidden detail, of a fluid pressurization device in accordance with the first aspect of the invention;

Figure 2 shows a shows a side view of the pressure container of the fluid pressurization device of Figure 1;

Figure 3 shows a schematic side view of the first inflatable bladder of the fluid pressurization device of Figure 1;

Figure 4 shows a schematic side view of the second inflatable bladder of the fluid pressurization device of Figure 1;

Figure 5 shows a schematic unfolded plan view of the sheet element of the fluid pressurization device of Figure 1;

Figure 6 shows a schematic side view of the first bladder of Figure 4, in a folded condition;

Figure 7 shows a schematic perspective view of the sheet element of Figure 5 in a rolled-up condition wherein it surrounds the folded first bladder depicted in Figure 6;

Figure 8 shows a schematic sectional end view of the fluid pressurization device for Figure 1, with the bladders in an uninflated condition;

Figure 9 shows a schematic sectional end view of the fluid pressurization device of Figure 1, with the bladders in an inflated condition; and

Figure 10 shows a schematic perspective view of an ordnance deflagration device in accordance with the second aspect of the invention;

Figure 11 shows a schematic perspective view, showing hidden detail, of another embodiment of an ordnance deflagration device in accordance with the invention;

Figure 12 shows a schematic sectional end view of another embodiment of a fluid pressurization device in accordance with the invention, in an uninflated condition; and

Figure 13 shows a schematic sectional end view of the fluid pressurization device of Figure 12, in an inflated condition thereof.

## DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to the drawings, a fluid pressurization device in accordance with the invention, is designated generally by the reference numeral 10. The fluid pressurization 10 comprises, broadly, a pressure container 12 and a first bladder

14, a second bladder 16 and releasable holding means in the form of a sheet element 18, that are located within the pressure container 12.

The pressure container 12 is in the form of a flexible bag of stitched fabric. It will be appreciated that the bag, while being flexible, has a fixed maximum volume when in a fully open condition. The pressure container 12 has two ends 20 and 22 with the end 22 being narrower than the end 20. As such, the pressure container 12 has a generally frusto-conical configuration when fully open. The end 20 of the pressure container 12 defines an opening 24.1 and the end 22 defines an opening 24.2.

The first bladder 14 is of resiliently deformable rubber and has two ends 26 and 28. The first bladder has a shape and dimensions identical to the shape and dimensions of the pressure container 12. The first bladder 14 defines an opening 30 at its end 26 in which a pipe connector 32 including a tyre valve 33, is located.

The second bladder 16 is of resiliently deformable rubber and has a first end 34 and a second end 36. The second bladder 16 has a shape and dimensions identical to the shape and dimensions of the pressure container 12. The second bladder 16 has an opening 38 at its end 36 in which a pipe connector 40 including a tyre valve 39, is located.

The sheet element 18 is of flexible fabric and has two ends 42 and 44. The fabric is formed by taking a rectangular sheet of fabric material and cutting off the corners of the sheet near its end 44, thereby providing the sheet element 18 with a tapered region 46 near its end 44.

The first and second bladders are located in the pressure container adjacent one another with the pipe connector 32 of the first bladder 14 extending through the hole 24.1 of the pressure container 12 and the pipe connector 40 of the second bladder 16 extending through the hole 24.2 of the pressure container 12.

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AMENDED SHEETS

The first and second bladders are located in the container with narrower ends thereof being disposed at the narrower end 22 of the pressure container. The second bladder 16 is folded in concertina fashion wherein folds of the bladder overlap one another as is shown in Figure 6 of the drawings. The sheet element 18 is wrapped around the folded second bladder 16 to form a roll surrounding the bladder in an arrangement wherein portions of the sheet element 18 overlap and contact one another. As such, the sheet element is rolled up around the folded second bladder 16 in an arrangement wherein the sheet element 18 contacts an inner side of the pressure container 22 and the first bladder 14. More particularly, the sheet element 18 is wrapped around the folded second bladder 16 in an arrangement wherein the tapered region 46 of the sheet element is disposed at the narrower end 34 of the second bladder 16.

In a particular application, the fluid pressurization device 10 is used in an ordinance deflagration device in accordance with the second aspect of the invention. With reference to Figure 10 of the drawings, an ordnance deflagration device in accordance with the invention, is designated generally in the drawings by the reference numeral 50. The ordnance deflagration device 50 comprises the fluid pressurization device 10, a torch 52 defining an outlet nozzle 53, that is connected via a delivery pipe 54 to the pipe connector 32 extending from the first bladder 14 and to a canister containing liquefied butane under pressure, via a delivery pipe 58. The pipe 58 has a valve 46 for controlling the flow of butane gas from the canister 56 to the torch 52.

The first bladder 14 is filled with oxygen to a pressure of 0.4 bar gauge pressure and the second bladder 16 is filled with compressed air to a pressure of 7 bar gauge pressure. As such, it is be appreciated that oxygen, being a volatile gas, is pressurized to a relatively much lower pressure then the non-volatile compressed air, the lower pressure of the oxygen makes the fluid pressurization device 10 safe for use in applications wherein it will be subjected to relatively

rough handling. The butane and the pressurized oxygen are mixed at the nozzle 53 of the torch 52, to produce a high temperature flame when ignited. The pipe 54 has a valve 47 for controlling the flow of oxygen to the torch 52.

Frictional forces acting between the overlapping portions of the sheet element 18 and the second bladder 16 in a hoop direction and frictional forces acting between the sheet element and the pressure container 22 and the first bladder 14, respectively, resist unrolling of the sheet element 18, thereby holding the second bladder 16 in its folded condition. In use, opening of the valve 47 allows pressurized oxygen to be discharged from the first bladder 14 into the delivery pipe 54 for mixing with the butane gas at the torch 52. As the oxygen in the first bladder 14 is delivered to the torch 52, the first bladder decreases in volume and as a result, the frictional forces acting on the second bladder decreases. As a consequence, the second bladder expands within the pressure container 12 exerting a force on the first bladder 14 for pressurizing the oxygen contained therein. The frusto-conical shape of the pressure container 12 and of the first and second bladders 14 and 16 and the tapered shape of the sheet element 18 assist in maintaining a near constant pressure of the oxygen within the first bladder 14.

The frictional forces acting between the overlapping regions of sheet element 18 in a hoop direction at the tapered region 46 of the sheet element, are relatively less than the frictional forces acting in a hoop direction between the overlapping portions of the sheet element at the opposite end 42, thereby causing the sheet element 18 to unravel relatively faster at the end 44 than at the end 42 of the sheet element. This allows the second bladder 16 to exert a relatively greater force on the first bladder 14 at its narrower end 28 relative to its wider end 26. The effect of the gradual unraveling of the sheet element ensures that a nearly constant pressure is maintained on the oxygen in the bladder 14. Further, the relatively greater force that is exerted on the first bladder 14 at its end 28 ensures that oxygen contained within the first bladder 14 is forced towards the wider end 26 of the first bladder (the end at which the pipe connector 32 is located) to

ensure that oxygen is not trapped in pockets within the bladder 14 as the second bladder expands within the pressure container 22 to take up the space within the pressure container 22 left by the shrinking bladder 14.

With reference to Figure 11 of the drawings, another embodiment of an ordnance deflagration device in accordance with the invention is designated generally by the reference numeral 60. In Figure 11, features of the device 60 that are the same and/or similar to those of the device 50, are designated by the same and/or similar reference numerals. The device 60 is similar to the device 50 with the only difference being that the canister 56 is replaced with a second fluid pressure device.

The device 60 thus includes two fluid pressurization devices 10.1 and 10.2 for delivering volatile combustible gases to the torch 52 where the gases are mixed and ignited, in use. In this example, the bladder 14 of fluid pressurization device 10.1 is inflated with oxygen to a gauge pressure of 0.4 bar, while the bladder 14 of fluid pressurization device 10.2 is inflated with liquid petroleum gas to a gauge pressure of 0.4 bar. The bladders 16 of the devices 10.1 and 10.2 are inflated with compressed air to a gauge pressure of 7 bar.

With reference to the Figures 12 and 13 of the drawings, another embodiment of a fluid pressurization device in accordance with the invention, is designated generally the reference numeral 100. In Figures 12 and 13, features of the device 100 that are the same and/or similar to those of the device 10 are designated by the same and/or similar reference numerals. The device 100 is the same as the device 10 with the only difference being that an additional inflatable bladder 114 is located in the pressure container 12 adjacent the bladder 14 at a side thereof remote from the bladder 16. The bladder 114 has a similar frusto-conical shape to that of the bladder 14 and has a connector pipe 132 including a tyre valve, through which the bladder 114 can be filled and fluid discharged therefrom, in use.

The Applicant envisages that the fluid pressurization device 100 can be used in an ordnance deflagration device to deliver two combustible fluids to a torch where the combustible fluids can be mixed and ignited to produce a high temperature flame. More particularly, as for the fluid pressurization device 100, the bladder 16 is filled with compressed air to gauge pressure of 7 bar and the bladder 14 is filled with oxygen to a gauge pressure of 0.4 bar. The bladder 114 is filled with liquid petroleum gas which is not pressurized, i.e. the liquid petroleum gas is at a pressure of 1 bar within the bladder. Delivery pipes are connected to the pipe connectors 31 and 32, respectively for connecting the bladders 14 and 114 to a torch in an arrangement similar to that of the ordnance deflagration device 60 illustrated in Figure 11 of the drawings. When the bladders 14 and 114 are located in the pressure container 12, the bladder 16 exerts a force on the bladder 14 which in turn exerts a force on the bladder 114 for pressurizing the fluid contained within each of the bladders 14 and 114. In similar fashion to the fluid pressurization device 10, a near constant delivery of combustible fluid can be achieved from the bladders 14 and 114.

The torch 52 of the ordnance deflagration devices 50 and 60 can be directed at the outer casing of an unexploded ordnance device such a land mine or a mortar shell. The high temperature flame delivered by the torch 52 softens the outer casing and burns therethrough igniting the contents. Typically, high explosive contained within the casing is suspended in an inflammable matrix. Once ignited, the matrix will burn through using the high explosive contained therein for wicking. Unexploded ordinance can thus be deflagrated rendering it safe without an explosion. The ordnance deflagration device in accordance with the invention will thus obviate the need to detonate exploded ordinance causing damage to the terrain and contamination of the area with explosive material which will in itself cause difficulty in the search for further unexploded ordinance.